THEATER IDENTIFICATION SYSTEM UTILIZING IDENTIFIERS PROJECTED ONTO A SCREEN

BACKGROUND OF THE INVENTION

[0001] The inventive arrangements relate generally to the field of protecting film against illegal copying, and in particular, to a method for identification of the source of films illegally copied by camcorders.

[0002] Piracy issues in connection with the theatrical exhibition of motion picture films are well known. Once a film distributor distributes prints of a motion picture film to exhibitors for theatrical exhibition, a certain degree of control over the product is lost. In the regular course of exhibiting the film, a customer in the theater may surreptitiously record the film using, for example, a hand held camcorder. At a more sophisticated level, a person seeking to obtain an illegal copy of a film print may gain access to a theater projection booth in collusion with an employee of the exhibitor and make a copy of the film after hours in a relatively controlled environment. In such an environment, the audio from the projection equipment can be directly fed to the camcorder. A tripod can be used to ensure a clear and steady picture. As a result, an illicit copy can be made.

[0003] In 1982, the Motion Picture Association of America (MPAA), together with the Kodak Corporation, developed a technology for uniquely identifying film prints. This technology is commonly known as Coded Anti-piracy (CAP) coding. The code is a series of faint dots in the picture that are added as the print is manufactured. Approximately one out of every hundred frames contains four tiny dots that have been added to the image. Generally, 11 CAP-coded frames are required to reconstitute the serial number of the movie print. Each unique configuration of dots corresponds to a print identifier.

[0004] The film prints are usually coded for each theater in which a film is distributed. If CAP coded films are re-used, for example in theaters specializing in the presentation of older films, the identification of a theater being used to make illegal film prints may become impossible. Thus, a new film print must be generated for each theater in which a film is to be shown. The generation of film prints is relatively expensive, however. Moreover, it is expensive and cumbersome to maintain a library of interpositives from which new film prints can be generated for subsequent re-releases of films. Thus, a method is needed for

identifying a theater in which an illegal copy of a film is made, regardless of whether the film is CAP coded.

SUMMARY OF THE INVENTION

[0005] The present invention relates to a method for identifying, or marking, a copy of an image sequence, e.g., a video or film, which is presented on a screen. Specifically, at least one identifier distinct from the image sequence is projected such that the identifier is displayed on the screen using visible light along with the image sequence. Illustratively, the identifier can be presented at periodic intervals and can define a theater location, a date and/or a time. An illumination and/or a color of at least a portion of the image sequence presentation can be measured. Based on the measured illumination and/or color, a projection brightness and/or color can be determined for the identifier. A projection location where the identifier should be projected on the screen also can be determined.

[0006] The invention also includes a system for identifying, or marking, a copy of an image sequence. The system comprises a projector for projecting onto a screen at least one identifier distinct from the image sequence such that the identifier is displayed on the screen using visible light along with the image sequence. The identifier can be presented at periodic intervals and can define a theater location, a date and/or a time. The system can include a detector for measuring an illumination and/or a color of at least a portion of the image sequence presentation. The system also can include a processor for determining projection brightness and/or color for the identifier based upon the measured illumination and/or color. The processor also can determine a projection location on the screen where the identifier can be projected.

BRIEF DESCRIPTION OF THE DRAWINGS

[0007] FIG. 1 is a diagram of a video projection system that is useful for understanding the invention;

[0008] FIG. 2 shows a frame containing an image onto which a marking pattern has been projected;

[0009] FIG. 3 shows an exemplary illumination/color detector which is useful for understanding the invention;

[0010] FIG. 4 is a flow chart, which is useful for understanding the invention;

[0011] FIG. 5 shows another illustrative embodiment in accordance with the principles of the invention; and

[0012] FIG. 6 shows an illustrative form of marking data in accordance with the principles of the invention.

DETAILED DESCRIPTION

[0013] An embodiment in accordance with the present invention pertains to a method for projecting one or more identifiers onto a projection screen during a video presentation to generate a marking pattern such that if the video presentation is recorded — the marking pattern is also recorded. Illustratively, the marking pattern can identify a location, or facility, where the video presentation occurred, as well as the date and time at which the video presentation occurred. Further, in addition to identifying a facility in which the video presentation occurred, the projection screen within the facility that was used for the presentation also can be identified. Thus, if an illicit copy of a film is made from a video presentation, the illicit copy can be evaluated to determine when and where the copy was made. Since this advantageous optical marking is performed during a video presentation, rather than on the print of the video, there is no potential problem with marking a print that may be subsequently used at a different location or for a different purpose.

[0014] Other systems have used infrared (IR) light sources to degrade a captured image in a capture device. While this works in many cases, it is subject to circumvention. Some image capture devices are not sensitive to infrared wavelengths of light, and those that are sensitive to infrared light can be used with commonly available IR filters to mask the infrared wavelengths. (Such as the XNiteCC137 sold by LDP Net, Woodcliff Lake NJ at www.maxmax.com.) However, and in accordance with the principles of the invention, by using small amounts of visible light to create marks in the captured image, the use of such filters is prevented, and the likelihood that the marks will not be noticed and/or removed by the operator of a rogue image capture device is increased.

[0015] Referring to FIG. 1, a system 100 is depicted for displaying a marking pattern on, or within, a video presentation. The system 100 can be disposed within a screen room, an editing facility, a theater, or any other location where a video presentation can occur. The

marking pattern can be displayed within the video presentation by projecting identifiers onto a screen 105 upon which the video presentation is projected. The marking pattern can be encoded with the location, date and time information. Thus, the marking pattern can be encoded into an illicit copy of video presentation recorded by an image capture device 150. In particular, the marking pattern will be detectable within frames of the illicit copy.

[0016] Referring to FIG. 2, an exemplary frame 200 having an identifier, or marking pattern, 210 is shown. The identifier 210 is distinct from the original image sequence. As defined herein, distinct from the original image sequence means that the identifier is not contained on the storage medium from which the original image sequence is presented. The identifier 210 can comprise one or more symbols 220, for example, one or more characters, dots, lines, geometrical shapes, or any other identifiable symbols that can be projected onto a screen. The identifiers can be projected onto the screen for a time period that is long enough to insure that the identifiers mark one or more frames within the copy.

[0017] The identifiers can be projected multiple times during a video presentation, in which case the identifier can be projected at predetermined intervals. The predetermined intervals can be determined by a time period, a number of frames, a number of scenes, or an interval measured in any other way. It should be noted that projecting the identifiers more than once within a video presentation can facilitate identification of the marking pattern in the event that one or more instances of the identifiers should become unreadable on an unauthorized copy of the video presentation.

[0018] Referring again to FIG. 1, a secondary projector 115 is illustratively employed to superimpose the identifiers onto displayed video. For example, in a first embodiment, the secondary projector 115 can be a projector that is often used to show advertising and auxiliary material prior to a feature presentation. Such projectors are known to the skilled artisan and are typically operated within a projection booth 120, proximate to a projector 125, which is used to project the video presentation. In operation, the secondary projector 115 is powered up in a 'dowsed' mode that produces no light. The dowsing is subsequently removed to project an image having one or more identifiers. Multiple identifiers can be presented concurrently and/or sequentially to form the marking pattern. In a preferred arrangement, images containing the identifiers have backgrounds that do not significantly

affect the displayed video, while the identifiers are detectable within the displayed video. For example the image background can be a dark color, such as black. After the identifiers have been projected, the secondary projector 115 can be turned off or returned to the dowsed mode.

[0019] In other illustrative embodiments, the secondary projector can be a liquid crystal display (LCD) projector, a digital light processing (DLP) projector, a liquid crystal on silicon projector (LCOS), or any other type of projector that can be configured to project the identifiers within the video presentation. LCD, DLP and LCOS projectors typically are digitally controlled. Such projectors can be advantageous in that brightness, color and location of identifiers on the screen 105 can be selectable. Varying the location of identifiers on the screen 105 can make the identifiers less noticeable to an audience, but also may make the identifiers harder to detect when attempting to read the marking pattern.

[0020] In yet another embodiment, the secondary projector 115 can be a light projecting device which employs a light source behind a rotating disk containing a pattern of dots. The dot pattern can form identifiers to define the theater identifier, and a clock motor can rotate one or more disks to provide time information. Further, the light source can be periodically flashed, with each flash lasting for a specific duration of time. It should be noted that although the secondary projector 115 is shown as a stand-alone device, the secondary projector 115 can be incorporated into the projector 125.

[0021] Notably, the secondary projector 115 can receive operating commands from a processing device 130, for example a personal computer, a network appliance, or any other suitable processing device that can generate operating commands for the secondary projector 115. The operating commands can be wirelessly propagated to the secondary projector 115 or propagated via a port or bus associated with the processing device 130. Further, the processing device 130 can be connected to a communications network. Thus, operation of the secondary projector 115 can be controlled from a remote location, for example from a central location within a theater or a location remote from the theater.

[0022] In another arrangement, the secondary projector 115 can adaptively modify the brightness, color and/or location of identifiers projected onto the screen 105, thereby mitigating the contradictory requirements of durably marking a copy of a video presentation

formed by an image capture device 150, while obviating or minimizing any audience distraction. The illumination and/or color of a light incident on the screen 105 during a video presentation can be measured with one or more suitable detectors (as represented by detector 160) that generate data correlating to the illumination and/or color of the light. Based on the data, the brightness and/or color of identifiers used in the marking pattern can be selected. Thus, the identifiers can be bright enough to be visible in a white scene area, but can be rendered unobjectionable during a dark scene.

[0023] Projection screens in most movie theaters are perforated, which allows loudspeakers to be positioned behind the projection screen to project sound through the perforations. However, light also can project through the perforations. Thus, the detector 160 can be placed behind the screen 105 to detect screen exit rays 165 which propagate through the perforations. In a preferred arrangement, the detector 160 can detect light in one or more areas of the screen 105 where the identifiers will be projected. The detector 160 can be calibrated to correlate the generated data to the color and/or illumination of the light incident on the screen 105.

[0024] The detector 160 can be operatively connected to the processing device 130 or directly to the secondary projector 115. For example, the processing device 130 can process illumination/color data received from the detector 160, e.g., via signaling 131, and forward commands to the secondary projector 115, via signaling 116, so that the secondary projector 115 projects the identifiers with the appropriate brightness and/or color. Also, in an embodiment in which placement of the identifiers on the screen 105 is selectable, commands can be forwarded to the secondary projector 115 to determine optimum identifier placement based upon the illumination and/or color characteristics of a scene currently being displayed. Although the processing device 130 is shown as being external to other devices, such processing also can be performed by a processor incorporated into the detector 160 or the secondary projector 115.

[0025] Referring to FIG. 3, an exemplary detector 160 is depicted. The detector 160 comprises one or more sensors 310 capable of detecting screen exit rays. Such sensors are commercially available from a number of vendors, for example from Konica Minolta Business Solutions U.S.A., Inc. of Ramsey, NJ 07446. When the detector includes a

plurality of sensors, measurement regions 320 can be defined. The illumination and/or color in the measurement regions 320 can be measured by the sensors 310. As shown, the detector 160 can be provided with sixteen (16) sensors 310, but the invention is not so limited and any number of sensors 310 can be provided. For instance, if higher resolution is desired, a greater number of sensors 310 can be provided. If lower resolution can be accommodated, a smaller number of sensors 310 can be provided.

[0026] In another arrangement the detector 160 can include a frame imaging camera sensor (imaging sensor). This is illustrated in FIG. 5, where detector 160 is located in front of screen 105 and measures the reflected light levels as represented by arrows 165. An image signal generated by the imaging sensor can be processed to provide a near real time spatial screen map of illumination and color information associated with a projected image. This screen map can be processed to adaptively control the brightness and color of identifiers generated by the secondary projector. Moreover, the screen map can be processed to determine optimal locations for identifiers on the screen. Ideally, the picture rate of the imaging sensor should be sufficiently rapid and the integration time should be sufficiently short so that the screen map can be established from a single projector shutter opening and the identifiers can be displayed during subsequent exposures of the current film frame. For example, the imaging sensor can be a high frame rate imaging device having low spatial resolution.

[0027] Referring to FIG. 4, a flow chart 400, which is useful for understanding the present invention is shown. Beginning at step 410, an image sequence is presented on a screen. An illumination and/or color of at least a portion of the image sequence is measured, as shown in step 420. Proceeding to step 430, the illumination and/or color information is processed to determine a brightness and/or color for identifiers projected onto the screen. The projection location of identifiers also can be determined based upon the measured illumination and/or color information. The identifiers are then projected onto the screen to form a marking pattern detectable within the video presentation, as shown in step 440.

[0028] It should be noted that the above-described marking pattern can be generated from marking data. As such, and in order to improve the ability to recover the marking pattern from a recovered pirate recording, an error-correction scheme may be used in the

marking pattern to increase the reliability of the data. This is illustrated in FIG. 6, which shows illustrative marking data for use in generating a marking pattern in accordance with the principles of the invention. In particular, marking data 505 comprises 5 bytes of data (bytes 0 through 4) for conveying a theatre ID comprising 14 bits as represented by TID0 through TID13 (bytes 0 and 1), a julian day of the year (0-364) as represented by bits Jul0 through Jul8 (byte 2 and a portion of byte 3) and a time of day in hour increments (0-23) as represented by bits Time0 through Time4 (the remaining portion of byte 3). As can be observed from FIG. 6, bytes 0 through 4 include parity bits, e.g., odd parity bits equal to the XNOR (exclusive NOR) of the other seven bits in each byte. Byte 4 represents a forward error correction (FEC) byte, which is illustratively defined as the XNOR of the other four bytes (bytes 0 through 3). The marking data is converted into a marking pattern, e.g., via processor 130 or projector 115, such that each bit value is represented by, e.g., a color, of one, or more, pixels of the marking pattern. Using this code, if one pixel (or group of pixels) is rendered invalid (e.g., in a subsequent recording), that byte may be corrected, and if one byte is rendered invalid, it can be also be recreated. Although this example uses a simple parity based code, it is clear that one skilled in the art could use one of any variety of error correcting codes, including by way of example, BCH-codes, Reed-Solomon codes, Goppa codes, or convolutional codes.

[0029] While the preferred embodiments of the invention have been illustrated and described, it will be clear that the invention is not so limited. Numerous modifications, changes, variations, substitutions and equivalents will occur to those skilled in the art without departing from the spirit and scope of the present invention as described in the claims.